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ABSTRACT

The current emphasis on objectives and test item banks for constructing more effective tests is being augmented by increasingly sophisticated computer software. Items can be catalogued in numerous ways for retrieval. The items as well as instructional objectives can be stored and test forms can be selected and printed by the computer. It is also possible to select and retrieve objectives from which a curriculum can be created tailored to personal choice. This paper describes a very flexible item banking computer program and its use with a longitudinal, criterion-referenced testing program called Comprehensive Achievement Monitoring (CAM), capable of both classroom management and curriculum evaluation. The CAM model includes item sampling techniques and several parallel test forms which would be particularly difficult to develop without the item banking computer programs. (Author)

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OBJECTIVE AND ITEM BANKING COMPUTER SOFTWARE AND ITS USE IN COMPREHENSIVE ACHIEVEMENT MONITORING

by

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(A paper presented at the Annual Meeting of the American Educational Research Association, New York, February, 1971.)

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Objective and Item Banking Computer Software
and Its Use in Comprehensive Achievement Monitoring

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Item banking and its logical predecessor objective banking are becoming increasingly important in educational measurement. Several projects, both in the U. S. and Britain, have investigated various forms of item banking. The motivation for these projects is usually the following:

1) To make available to educators better test items for use in examinations in schools;
2) To provide test items with known item characteristics so that test results will be more valid and reliable than those based on locally developed items and that test results from one setting can be compared with those from another setting;
3) To make teachers more familiar, in general, with modern notions of test construction including the classification of test items by categories which they measure, e.g., behavioral objectives;
4) To utilize test items, which are written by skilled authors, in many contexts without the added costs of writing new ones; and
5) To provide a basis for better decision-making regarding the placement and instructional treatment of students which will minimize losses in student's time and effort.

Objective and item banking require several operations including stocking of the bank, retrieving information from the bank, and using the retrieved information in a variety of testing situations. Each of these operations could be used to characterize existing or future objective and item banks. Stocking the bank consists of writing or compiling objectives and items which have been classified by content and characterized by item statistics. Retrieving from the bank consists of finding the objectives and items which are appropriate to the purpose for which they will be used. Using materials from the bank

consists of diagnostic testing, placement testing, criterion-referenced testing within a course, pre-testing for the different instructional treatments, or testing on a longitudinal basis using item sampling.

Existing efforts in objective and item banking may be characterized by their purpose and operation. One of the most publicized efforts is the Instructional Objective Exchange, IOX (Popham, 1970). IOX is an attempt to make available to teachers instructional objectives, with a grade level, content, and taxonomical classification of objectives, and sample test items. These materials are made available in the form of mimeographed booklets for specific subject areas and grade levels. The materials are not distributed in a form that can be used directly, i.e., the objectives are not printed in the form that could be transferred to a specific school situation, test items are not numerous enough or appropriately formated to constitute a test. IOX is not directed toward immediate implementation of objectives or testing programs but more as a guide toward development of locally based objectives and items.

A second major effort would be the Computer-Based Test Development Center, COMBAT (Walter, 1970). The major purpose of COMBAT is to make a large number of teacher written test questions available to classroom teachers for their classroom testing. The classification for test items is by key work and the item statistics are not measured. The storage and retrieval of the items is done by computer. They can be printed immediately in a form which can be used as a classroom test. The computer printing can be done on masters which duplicate more copies. The testing materials are designed for usual classroom testing.

A more sophisticated bank, because extensive information about item characteristics are available, was produced at the National Foundation for Educational Research in England and Wales. The work of the Foundation is described by Wood and Skurnik (1969). The item bank includes items which can be used by school-based examiners to determine the score of students in the certification of secondary education in England and Wales in mathematics. Extensive work went into the development of the item bank. Items were classified by task. They were pretested so that their item characteristics were known. The storage and retrieval of items is from a card file.

Another effort in objective and item banking is the focus of this paper. The banking system has been developed by the Project for Comprehensive Achievement Monitoring, CAM (Gorth, 1968). CAM has developed a model of evaluation

useful in curriculum evaluation and classroom management. The model consists of longitudinal testing, using item sampling, of the specific behavioral objectives for a course. In order to support the testing activity, which uses a large number of test forms, and therefore, a large number of test items, computer programs were developed to streamline test development.

All of the items in the CAM item bank have been classified in at least three dimensions: their content, their taxonomical level, and the sequence in which they are taught in the typical school course. The relationships between items and objectives are referenced and item analysis information at pretest, posttest, and retention time intervals is available. Both the objectives and the test items are stored on magnetic tape. The classification of items and their relation to the objective is also recorded in the computerized item bank. The objectives and items may be selected on a preliminary basis for perusal by individual teachers or for establishing a bank consisting of a subset of the total objectives and items. After final selection and allocation to test forms, the tests can be printed in an easily duplicatable format. The answer keys for the tests are both printed as well as punched into computer cards for quick analysis by other programs available from CAM (Gorth, Grayson, and Lindeman, 1969; Gorth, Grayson, and Stroud, 1969; Gorth, Grayson, Popejoy, and Stroud, 1969).

The CAM Computer Programs

Subsystem 1: Storage and Editing of Objectives and Items

Input. The input into the computer program for storing objectives and items consists of data cards which contain up to 15 classifiers for the objectives and items and the text of the objectives and items in the format in which it will be later printed. The capability exists for modifying and adding to classifiers and texts of the objectives and items already stored in the banks.

Output. The output from the computer program is a magnetic tape of the selected objectives and items and its printed listing.

Subsystem 2: Preliminary Selection of Objectives and Items

Input. The second computer program selects objectives and their associated test items by the criteria selected by the teacher.

Output. The output consists of:

(1) A printout of the objective on one side of the printout page and the associated items listed on the other side. (See insert 1 for an example.) The item is printed out in the format which would be used on a test and the correct answer is indicated by a leading asterisk.

(2) A magnetic tape containing the objectives and items initially selected. This tape, containing the preliminary selection of objectives and items, is much shorter than the original tape and precludes having to search the master tape again for the same subset objectives and items before the tests are finally printed. The tape can be developed to serve as a local bank tailored to the local needs and can be distributed for local use. An example is a school system with specified curricula for its science programs, so the tape would contain science objectives and items selected as pertinent to the specified curricula.

Subsystem 3: Objective and Test Printing

Input. The computer tape containing the subset of objectives and items constituting the selection by preliminary criteria by teachers is used as the major input for the final stage of the objective-item banking sequence.

Output. The output consists of tests printed in a form which can be readily duplicated and administered. (See insert 2 for an example.) The tests may be printed on duplication masters or directly on multipart, computer output paper. Objectives associated with the tests are printed out in a form easy to duplicate and distribute to students. The objectives are coded with numbers selected by the teacher to fit the pattern and sequence of the curriculum as he organized it.

Elaboration on the Use of the Objective and Item Bank for the Construction of Tests

The use of a computer program to compose and print actual test forms effectively reduces the chance of errors on the forms and saves hours of personnel time in the construction and reproduction of the forms. Errors introduced in preparing test masters and miskeying of answers are eliminated.

The program saves man-hours in its use of item sampling procedures where items must be randomly selected and randomly assigned to test forms. It also randomizes alternatives to multiple-choice items before they are printed out in the final version of the test and it further provides answer keys. In longitudinal testing situations such as CAM where the use of multiple test forms is necessary, the labor saving is immense.

Examples of Projects Using an Objective and Item Bank in Conjunction With a CAM System

For a high school biology course in Duluth, Minnesota we have not only analyzed their test data but printed the test forms for the course by computer.

Currently at the college level we have an item bank for a graduate educational statistics course for which we print tests and analyze the data.

A high school history course at Hopkins High School in Minnesota uses tests we have prepared by computer in a Title III project devoted to implementing CAM on a school-wide basis.

We are now in the process of building an objective and item bank in reading using material from the CAM project at Ballston Spa, New York.

A fifth component of our current bank is a classroom evaluation course for teachers. For this course we print tests, analyze the data, and have the teachers in the course interpret their own results.

Future Utility and Role of a Comprehensive Objective and Item Bank

The use of an objective and item bank can go beyond the major desired results of providing a tailored curriculum for a teacher and efficient tests for student, course, and curriculum evaluations. These two results could be extended and enlarged through the organization of libraries of computer tapes which are subsets of the master library bank. Efficient means of tape creation, distribution, and continuous updating should be instituted so that the master bank could service hundreds of schools. Feedback from teachers who create new objectives and items and use existing bank materials in new situations could be a major component in bank modification.

Non-access to computers could be bypassed by the distribution of the objectives and items on microfiche.

Such a bank should be an encouragement to teachers to build well-organized courses and curricula and yet ones which are flexible and diversified. Teachers need not create a curriculum in toto from bank materials but should be encouraged to pick and choose objectives and items to add to their own and to use the bank in determining an instructional sequence of objectives. The bank would then serve to lessen the effort needed to revise their curricula. The freedom to add or remove curricular segments in an easy manner would aid in lessening a teacher's dependence on one set of texts or the current collection of materials at hand. Further, it is hoped that motivation would arise to create learning situations for the previously refined and proven behavioral objectives which would be more effective for students than former practices based on a vaguer and less well organized curriculum.

The common-core curriculum that could be formed if large numbers of schools used the banks resources could lead to statewide longitudinal testing programs which could be formulated with item and student sampling and serve as effective substitutes for such state evaluation programs as the New York State regents tests.

* * *

More detailed information about the computer programs of the bank may be found in the following reference:

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.C.	QUES.	
15 MICROSCOPE- THE STUDENT WILL KNOW SOME OF THE TYPES OF MICROSCOPES USED IN BIOLOGICAL STUDIES. THE STUDENT WILL KNOW THE ESSENTIAL PARTS AND PROPER USE OF THE COMPOUND MICROSCOPE. THE STUDENT WILL KNOW THE PROPER WAY TO USE PREPARED SLIDES AND HOW TO MAKE SLIDES FROM COLLECTED MATERIALS.	11 -0 15 Q THE PRINCIPLE ADVANTAGE OF AN ELECTRON MICROSCOPE OVER THE Q VISIBLE LIGHT MICROSCOPE RESULTS FROM THE • 1 SHORTER WAVE LENGTH OF ELECTRON WAVES AS COMPARED WITH • 1 VISIBLE LIGHT WAVES 2 A GREATER PENETRATING POWER OF ELECTRON WAVES AS COMPARED 2 WITH VISIBLE LIGHT WAVES 3 DIFFERENCES IN SIZE OF THE MICROSCOPE 4 SPECIAL ABILITY OF THE ELECTRON MICROSCOPE FOR VIEWING 4 LIVING MATERIAL 5 ELECTRICAL CHARGE ON THE ELECTRON WAVES	
15	12 -0 15 Q IF YOU NEEDED MORE LIGHT TO VIEW A SLIDE YOU WOULD USE THE: • 1 DIAPHRAGM 2 STAGE CLIPS 3 OCULAR 4 BODY TUBE 5 OBJECTIVES	
15	13 -0 15 Q WHEN YOU BEGIN TO LOOK FOR SOMETHING ON THE SLIDE YOU SET Q THE MICROSCOPE ON THE: • 1 LOW POWER OBJECTIVE 2 HIGH POWER OBJECTIVE 3 OCULAR 4 FINE ADJUSTMENT 5 COARSE ADJUSTMENT	
15	14 -0 15 Q YOU MAY REMOVE AIR BUBBLES FROM A WET MOUNT BY; 1 TAPPING THE COVER GLASS WITH YOUR FIST • 2 TAPPING THE COVER GLASS WITH A PENCILL ERASER 3 ADDING MORE WATER 4 BY HOLDING THE SLIDE ON AN ANGLE 5 PRESSING COVER GLASS WITH YOUR THUMB TO SQUEEZE THEM OUT	
15	15 -0 15 Q THE TYPE OF MICROSCOPE YOU WILL USE IN CLASS MOST OF THE Q TIME IS THE 1 DISSECTING MICROSCOPE 2 ELECTRON MICROSCOPE 3 HAND MICROSCOPE 4 PHASE-CONTRAST MICROSCOPE • 5 COMPOUND MICROSCOPE	
20 CELL STRUCTURE-THE STUDENT SHOULD BE ABLE TO ANSWER QUESTIONS THAT WOULD BE RELATED TO ONLY A PLANT OR ANIMAL CELL OR BOTH BY KNOWING THE STRUCTURES AND CELL CONTENTS OF BOTH PLANT AND ANIMAL CELLS.	16 -0 20 Q MOST PLANTS CELLS CAN MAKE THEIR OWN FOOD. THIS IS POSSIBLE Q BECAUSE OF • 1 CHLOROPHYLL 2 CELL WALLS 3 MITOCHONDRIA 4 ASTERS 5 THE NUCLEUS	

10

insert 1

QUESTION 1
WHICH OF THE FOLLOWING MATERIALS OR SOURCES WOULD YOU CONSIDER MOST RELIABLE TO GIVE A TRUE PICTURE OF THE BATTLE OF THE MARNE, SEPTEMBER, 1914.

A. AN ACCOUNT COMPILED FROM MATERIAL TAKEN FROM REPORTS OF OPPOSING COMMANDERS.
B. AN ACCOUNT APPEARING IN A JOURNAL PRINTED IN A NEUTRAL COUNTRY.
C. AN ACCOUNT WHICH CONTRASTED THE SPIRIT OF THE HEROIC BOYS OF THE ALLIES AND THE PONDEROUS FOOLHARDINESS OF THE ENEMY.

QUESTION 2
WHICH OF THE FOLLOWING MATERIALS OR SOURCES WOULD YOU CONSIDER MOST RELIABLE TO GIVE A TRUE PICTURE OF THE PROBLEMS FACING HIGH SCHOOL DROPOUTS.

A. A PUBLICATION BY THE U. S. DEPARTMENT OF LABOR ON THE LIMITED JOB OPPORTUNITIES AVAILABLE TO DROPOUTS.
B. A TV DOCUMENTARY ON SCHOOL DROPOUTS IN WHICH TEN DROPOUTS ARE INTERVIEWED.
C. AN ARTICLE ON THE PROBLEMS A DROPOUT MUST FACE IN SCHOOL AND SOCIETY MAGAZINE WRITTEN BY A FAMOUS SOCIOLOGIST.

QUESTION 3
WHICH OF THE FOLLOWING MATERIALS OR SOURCES WOULD YOU CONSIDER MOST RELIABLE TO GIVE A TRUE PICTURE OF DWIGHT D. EISENHOWSER AS A GENERAL.

A. A U. S. ARMY HISTORIAN≠S ACCOUNT OF EISENHOWER≠S MILITARY CAREER.
B. A MOVIE DEPICTING THE LIFE OF GENERAL EISENHOWER.
C. AN ACCOUNT WRITTEN BY HIS WIFE, MAMIE, ABOUT THEIR YEARS TOGETHER.

QUESTION 4
WOULD YOU CLASSIFY THE FOLLOWING ITEM AS A SOURCE OR A SECONDARY ACCOUNT FOR THE EVENT IT DESCRIBES.
A PHOTOGRAPH OF THE BURNING OF THE AIRSHIP HINDENBURG.

A. SECONDARY ACCOUNT.
B. SOURCE.

QUESTION 5
WOULD YOU CLASSIFY THE FOLLOWING ITEM AS A SOURCE OR A SECONDARY ACCOUNT FOR THE EVENT IT DESCRIBES.
A PAPYRUS ROLL USED BY THE EGYPTIANS.

A. SECONDARY ACCOUNT.
B. SOURCE.